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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/567,929	11/09/2006	Michael Duerr	285450U/S8X PCT	5376
22850 7590 03/10/2011 OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, L.L.P. 1940 DUKE STREET ALEXANDRIA, VA 22314				
EXAMINER HO, ANTHONY				
ART UNIT 2815		PAPER NUMBER		
NOTIFICATION DATE 03/10/2011		DELIVERY MODE ELECTRONIC		

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary

Application No.

10/567,929

Applicant(s)

DUERR ET AL.

Examiner

ANTHONY HO

Art Unit

2815

Period for Reply -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 May 2010.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6, 8-13 and 15-26 is/are pending in the application.
- 4a) Of the above claim(s) 15, 19, 25 and 26 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6, 8-13, 16-18 and 20-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-946)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 5/18/2010
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

This is in response to amendment to application no. 10/567,929 filed on May 18, 2010.

Claims 1-6, 8-13, and 15-26 are presented for examination.

Claims 15, 19, 25, and 26 stand withdrawn.

Information Disclosure Statement

1. The information disclosure statement (IDS) submitted on May 18, 2010 was filed after the mailing date of the Non-Final Rejection on February 19, 2010. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 4 and 5 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4. Claim 4 recites, "wherein said carbon nanotubes are a mixture of metallic and semiconducting carbon nanotubes." However, it is unclear from claim 1, in which claim 4 depends upon, that the carbon nanotubes are in mixture form. For example, the claims do not recite "some" of the carbon nanotubes are metallic. It is well known in the art that carbon nanotubes in metallic form do not have a band gap. Claim 5 recites,

"wherein said carbon nanotubes are a mixture of multi-walled and single-walled carbon nanotubes." However, it is unclear from claim 1, in which claim 4 depends upon, that the carbon nanotubes are in mixture form. Thus, one of ordinary skill in the art would not be able to define the metes and bounds of the claimed invention.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1-4, 6, 8-10, 13, 16-18, and 21-24 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Kymakis et al, "Single-Wall Carbon Nanotube/Conjugated Polymer Photovoltaic Devices," Applied Physics Letters, American Institute of Physics. New York, US, vol. 80, no. 1, 7 January 2002 (2002-01-07), pages 112-114 with support of Dukovic et al, "Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes," Nano Letters, Vol. 5, No. 11 (pp. 2314-2318) 2005 (teaching reference).

In re claims 1 and 13, Kymakis et al discloses a photovoltaic device, comprising a composition of carbon nanotubes and of at least one organic compound (Figure 1; page 112, column 1, lines 24-26).

Dukovic et al teaches the band gap of SWNTs are dependent upon the diameter of the carbon nanotubes and are defined by equation (4) – band gap = $(0.34 \text{ eV}/d_t) + (1.11 \text{ eV}/(d_t + 0.11))$ (i.e. page 2317, first column).

Kymakis et al discloses using SWNTs, in which their diameter is 1.4 nm (i.e. page 112, second column). Substituting 1.4 nm for d_t in equation (4) above, the band gap obtained is 0.978 eV.

Thus, Kymakis et al has a composition of carbon nanotubes (in this case, SWNTs), wherein the band gap of said carbon nanotubes lies in the range of from about 0.5 to about 1 eV (in this case, the band gap is 0.978 eV).

In re claim 2, Kymakis et al discloses the first and second electrodes are made of ITO and aluminum (page 113, column 2, line 9).

In re claim 3, Kymakis et al discloses the material used in the device is P3OT.

In re claim 4, Kymakis et al discloses the carbon nanotubes are a mixture of metallic and semiconducting carbon nanotubes (page 112, column 1, line 36 – column 3, line 2).

In re claim 6, Kymakis et al discloses the carbon nanotubes have a diameter of 1.4 nm (page 112, column 2, line 9).

In re claim 8, Kymakis et al discloses the band gap of at least one of the hole conductor lies in the range of from about 1 eV to 3 eV (page 113, column 1, lines 23-26).

In re claim 9, Kymakis et al discloses the LUMO of P3OT is 2.85 eV (page 114, column 1, lines 29-30), its bandgap 2.4 eV (page 113, column 1, line 24), addition of these values results in a HOMO of 5.25 eV which is greater than the HOMO of the carbon nanotubes (page 114, column 1, lines 16-17).

In re claim 10, Kymakis et al discloses the composition comprises a mixture of carbon nanotubes and at least one hole conductor (page 112, column 2, lines 5-17).

In re claim 16, Kymakis et al discloses the hole conductor is one of the listed materials, P3OT.

In re claim 17, the recitation "wherein it is an organic solar cell" in the claim preamble specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim

invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

In re claim 18, Kymakis et al discloses the one of the electrodes is a film or layer of a transparent material, ITO.

In re claim 21, Kymakis et al discloses a glass substrate (i.e. Figure 1).

In re claim 22, it is well known in the art that a flexible polymer substrate is used in photovoltaic devices.

In re claim 23, the recitation "a combination of the device according to claim 1 with a circuit, wherein the device acts as an internal power supply" in the claim preamble specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim invention from the prior art. If the prior art structure is capable of performing the

intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

In re claim 24, the recitation "a solar cell" in the claim preamble specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

Claim Rejections - 35 USC § 103

8. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kymakis et al, "Single-Wall Carbon Nanotube/Conjugated Polymer Photovoltaic Devices,"

Applied Physics Letters, American Institute of Physics. New York, US, vol. 80, no. 1, 7 January 2002 (2002-01-07), pages 112-114 with support of Dukovic et al, "Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes," Nano Letters, Vol. 5, No. 11 (pp. 2314-2318) 2005 (teaching reference) as applied to claim 1 above, and further in view of Tsukamoto et al (JP 2003-096313).

Kymakis et al, with support of Dukovic et al, as discussed above, does not disclose the carbon nanotubes are a mixture of multi-walled and single-walled carbon nanotubes.

However, Tsukamoto et al discloses the carbon nanotubes are a mixture of multi-walled and single-walled carbon nanotubes (paragraph 0008).

The advantage is to increase the mobility of the semiconductor device (i.e. paragraph 0005).

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the photovoltaic device as taught by Kymakis et al with support of Dukovice et al with the carbon nanotubes are a mixture of multi-walled and single-walled carbon nanotubes as taught by Tsukamoto et al in order to increase the mobility of the semiconductor device.

9. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kymakis et al, "Single-Wall Carbon Nanotube/Conjugated Polymer Photovoltaic Devices," Applied Physics Letters, American Institute of Physics. New York, US, vol. 80, no. 1, 7 January 2002 (2002-01-07), pages 112-114 with support of Dukovic et al,

"Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes," Nano Letters, Vol. 5, No. 11 (pp. 2314-2318) 2005 (teaching reference) as applied to claim 1 above, and further in view of Forrest et al (US Patent 6,451,415).

Kymakis et al, with support of Dukovic et al, as discussed above, does not disclose a multilayer structure for photovoltaic devices. However, Forrest et al discloses a multilayer structure for photovoltaic devices (Figure 2D).

The advantage is for efficient charge carrier generation (column 8, lines 51-65). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the photovoltaic device as taught by Kymakis et al with support of Dukovic et al with a multilayer structure for photovoltaic devices as taught by Forrest et al in order for efficient charge carrier generation.

10. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kymakis et al, "Single-Wall Carbon Nanotube/Conjugated Polymer Photovoltaic Devices," Applied Physics Letters, American Institute of Physics. New York, US, vol. 80, no. 1, 7 January 2002 (2002-01-07), pages 112-114 with support of Dukovic et al, "Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes," Nano Letters, Vol. 5, No. 11 (pp. 2314-2318) 2005 (teaching reference) as applied to claim 2 above, and further in view of Ganzorig et al, "Alkali metal acetates as effective electron injection layers for organic electroluminescent device," Materials

Science and Engineering B, Elsevier Sequoia, Lausanne, Ch, vol. 85, no. 2-3, 22 August 2001 (2001-08-22), pages 140-143.

Kymakis et al, with support of Dukovic et al, as discussed above, does not disclose the addition of an LiF, CsF or Li-acetate interlayer between the Al electrode and the organic hole conducting compound layer.

However, Ganzorig et al discloses the addition of an LiF, CsF or Li-acetate interlayer between the Al electrode and the organic hole conducting compound layer (Abstract). The advantage is to lower the work function of the Al layer and thus enhance hole transfer from the organic compound to the Al electrode (Abstract).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the photovoltaic device as taught by Kymakis et al with support of Dukovic et al with the addition of an LiF, CsF or Li-acetate interlayer between the Al electrode and the organic hole conducting compound layer as taught by Ganzorig et al in order to lower the work function of the Al layer and thus enhance hole transfer from the organic compound to the Al electrode.

Response to Arguments

11. Applicant's arguments filed May 18, 2010 have been fully considered but they are not persuasive.
12. In response to applicant's argument that it is conventionally known that other factors also influence the value of the band gap, examiner asserts that one of ordinary skill in the art would tailor the band gap of a carbon nanotube for different type of

applications. Even though applicant have submitted in an attached IDS an article by Weisman et al stating that band gaps depend on chiral angle in addition to diameter, the facts in Wiesman do not draw question to the facts established in Dukovic. In fact Dukovic discusses that chirality (page 2316, right column), and indicates that in creates a variation by "a few percent". Therefore, the carbon nanotubes of Kymakis would have a bandgap of approximately .9 ev, plus or minus a few percent. The .978 of Dukovic plus a few percent would still meet about 1%.

13. In response to applicant's argument regarding claims 4 and 5, examiner asserts that it is unclear from claim 1, in which claims 4 and 5 depend upon, that the carbon nanotubes are in mixture form. For example, the claims do not recite "some" of the carbon nanotubes are metallic. It is well known in the art that carbon nanotubes in metallic form do not have a band gap. Thus, one of ordinary skill in the art would not be able to define the metes and bounds of the claimed invention.

Conclusion

14. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANTHONY HO whose telephone number is (571)270-1432. The examiner can normally be reached on M-F: 10:30PM-7:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/A. H./
Examiner, Art Unit 2815
/Ken A Parker/
Supervisory Patent Examiner, Art Unit 2815